

**TENTATIVE SPECIFICATION
FOR
BITUMINOUS CONCRETE
(ASPHALTIC CONCRETE)
FOR
AIRFIELD PAVEMENTS**



**THE INDIAN ROADS CONGRESS
1996**

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TENTATIVE SPECIFICATION FOR BITUMINOUS CONCRETE (ASPHALTIC CONCRETE) FOR AIRFIELD PAVEMENTS

1. INTRODUCTION

Tentative Specification for Bituminous Concrete (Asphaltic Concrete) for Airfield Pavements was under consideration with the erstwhile Bituminous Pavements Committee. The Bituminous Pavement Committee in their meeting held on the 13th March, 1987 constituted a Working Group with Convenor from Central Road Research Institute and members from Gujarat Engineering Research Institute, International Airports Authority of India, Highways Research Station, Madras and Central Public Works Department for early finalisation of the document. The draft was finalised by the Working Group under the Chairmanship of Shri R. S. Shukla and members Shri H. K. Kulshrestha of I.A.A.I., Shri Balbir Singh of C.P.W.D., Shri A. P. Joshi of G.E.R.I., and the Deputy Director, incharge of Bitumen laboratory of H.R.S., Madras. The draft was discussed in detail by the Flexible Pavement Committee (personnel given below) in their meeting held at Madras on the 30th September, 1988 which authorised the Member-Secretary to finalise the document on the basis of the comments of the members of the committee.

Prof. C. G. Swaminathan	...	<i>Convenor</i>
P. Bhaskaran	...	<i>Member-Secretary</i>
R. T. Atre		Rep. of I.O.C.
G. R. Ambwani		(S. S. Das Gupta)
Dr. M. P. Dhir		Rep. of Hindustan Petroleum
R. A. Goel		Corporation Ltd.,
Dr. A. K. Gupta		(R. C. Arora)
M. B. Jayawant		Rep. of I.I.T. Kharagpur
P. K. Lauria		(Dr. B. B. Pandey)
Sekhar Mukherjee		Rep. of Bharat Petroleum
Anil T. Patel		Corporation Ltd.
T. H. Peshori		(A. D. Nayak)
R. K. Saxena		The President IRC
A. Sankaran		(J. M. Malhotra)
R. S. Shukla		The DG (RD) (K. K. Sarin)
N. Sen		The Secretary IRC
Director, HRS Madras		(Ninan Koshi)

The tentative specification as finalised by the Member-Secretary was considered and approved by the Highways Specifi-

cations & Standards Committee in their meeting held at New Delhi on the 24th November, 1988. The specification got the approval of the Executive Committee by circulation and the Council in their meeting held on the 10th December, 1988.

2. SCOPE

2.1. This tentative specification deals with the basic outlines for the design, construction and controls needed while laying bituminous concrete (Asphaltic Concrete) surface course mixes for airfields.

2.2. Bituminous concrete shall be used as a surface course and normally it should not be laid directly over water bound macadam or any granular base.

2.3. The work shall consist of constructing single layer of bituminous concrete upto 50 mm thickness and the mix shall consist of mineral aggregates and appropriate binder mixed in a hot mix plant and laid with a paver on a previously prepared bituminous/cement concrete base to the requirements of the specification described herein and conforming to the lines, grades and cross sections.

3. DESIGN CRITERIA

Bituminous concrete mixes should be properly designed so as to satisfy certain criteria needed to assure adequate stability and durability. The mix as designed and laid should satisfy requirements given in Table 1 based on Marshall method of design, which is suggested for the present for the sake of simplicity and uniformity.

TABLE 1. REQUIREMENT OF THE MIX

(i) Marshall Stability (ASTM Designation; D 1559) determined on Marshall Specimens compacted by 75 compaction blows on each end, in kg (minimum)	820
(ii) Marshall flow, (mm)	2— 4
(iii) Per cent voids in mix	3— 5
(iv) Per cent voids in mineral aggregate filled with bitumen	75—85
(v) Per cent voids in mineral aggregate (VMA)	13—16
(vi) Binder content per cent by weight of total mix (to be decided on Marshall design method)	5—7.5

Notes :

- (1) It is suggested that higher stability values consistent with other requirements should be achieved as far as possible. Also at touch-down areas and at taxi-tracks it is recommended that near minimum flow values be specified.
- (2) The binder content in the case of slag is likely to exceed the limit indicated in the Table.

4. MATERIALS

4.1. In order to satisfy the above mentioned requirements, the bituminous concrete mix shall consist of coarse aggregate, fine aggregate and filler in suitable proportions and mixed with sufficient binder. True and representative samples of the aggregates likely and proposed to be used on the specified job shall be tested in the design laboratory and proper blend of the aggregates shall be worked out so that the gradation of the final composition will satisfy either of the two limits set forth in Table 2.

TABLE 2. GRADATION OF MINERAL AGGREGATE

Sieve Size	Per cent by weight passing the sieve	
	40 cms	50 cms
22.4 mm	—	100
13.2 mm	100	85—100
11.2 mm	85—100	75—90
5.60 mm	60—75	58—70
2.36 mm	45—55	45—55
600 μ m	23—35	23—35
300 μ m	16—24	16—24
150 μ m	10—16	10—16
75 μ m	6—9	6—9

Note : The binder content (for both gradings) by weight of total mix shall be in the range of 5 to 7.5 per cent.

The exact binder content required shall be arrived at as per Marshall procedure for the aggregate gradation worked out in the laboratory and by using the same bituminous binder proposed or likely to be used in the field.

4.2. The materials shall further satisfy the following physical requirements :

4.2.1. **Bitumen** : Bitumen shall be paving bitumen of suitable penetration grade within the range of S 35 to S 90 or A35 to A 90 (30/40 to 80/100) as per Bureau of Indian Standards specification for Paving Bitumen IS : 73-1961. The actual grade of bitumen to be used, shall be decided by the Engineer-in-charge, appropriate to the region, traffic and environmental conditions.

4.2.2. **Coarse aggregate** : The coarse aggregate shall be crushed material retained on IS 2.36 mm sieve and shall be

crushed stone, crushed air cooled slag, crushed gravel (shingles) and shall consist of angular fragments, clean, tough and durable rock, free from disintegrated pieces and organic or other deleterious matter and adherent coatings. The aggregate shall not contain more than 6 per cent by weight of flat/elongated pieces (flat piece is one having ratio of "width/thickness is more than 4; elongated piece is where the ratio "length/width" more than 4). The aggregates shall preferably be hydrophobic and of low porosity. If hydrophillic aggregates are to be used bitumen shall be treated with anti-stripping agents of appropriate quality in suitable doses. In case of porous aggregate having water absorption of more than 1 per cent, extra bitumen for absorption by aggregates shall be provided to satisfy the design criteria. Water absorption upto 2 per cent could be permitted in exceptional cases. The aggregate shall also satisfy the physical requirements as given in Table 3.

TABLE 3. PHYSICAL REQUIREMENTS OF MINERAL AGGREGATE

Test	Maximum (Per cent)	Test Method
Aggregate Impact Value* or Los Angeles Abrasion Value*	30	IS : 2386 (Part IV)
Flakiness index	40	IS : 2386 (Part IV)
Stripping value	25	IS : 2386 (Part I)
Soundness	25	IS : 6241
(1) Loss with sodium sulphate— 5 cycles	12	IS : 2386 (Part V)
(2) Loss with magnesium sulphate—5 cycles	18	IS : 2386 (Part V)
Water absorption	1	IS : 2386 (Part VII)

Notes :

- (1) *Aggregate shall satisfy requirements of either of the two tests.
- (2) If crushed slag is used, it shall be made from air cooled blast furnace slag. It shall be of angular shape reasonably uniform in quality and density and generally free from thin elongated and soft pieces, dirt or other deleterious materials. The unit weight of the crushed slag shall not be less than 1120 kg per m and percentage of glossy materials shall not be more than 20. It should also comply with the following requirements :
 - (i) Chemical Stability—To comply with requirements of appendix of BS 1047
 - (ii) Sulphur content —Maximum 2 per cent
 - (iii) Water absorption —Maximum 10 per cent

4.2.3. Fine aggregate : Fine aggregate shall be the fraction passing 2.36 mm sieve and retained on 75 μ m sieve consisting of crusher run screening, natural sand or a mixture of both, it shall be clean, hard, durable, dry and free of adherent coatings, soft and flaky pieces and organic or other deleterious substances.

4.2.4. Filler : The requirement of filler in bituminous concrete shall normally be met by the material passing 75 μ m sieve in fine aggregate if any. In case the fine aggregate is deficient in material passing 75 μ m sieve, extra filler shall be added. The filler shall be an inert material the whole of which passes 600 μ m sieve, at least 90 per cent passing 150 μ m sieve and not less than 70 per cent passing 75 μ m sieve. The filler shall be stone dust, cement, hydrated lime, fly ash or any other approved non plastic mineral matter.

5. JOB MIX FORMULA

5.1. While the laboratory mix design gives the different proportions of the mineral aggregate combinations in terms of individual sieve sizes of aggregate blending of aggregates (each size having within a range of individual sieve sizes) would be necessary. This blending ratio is obtained on a weight basis, giving the per cent weight of the coarse aggregate, fine aggregate and filler to give the ultimate aggregate gradation. It can also be proportioned on a volumetric basis based on the unit weight of bulk density of the aggregate supplied. This mineral aggregate combination together with the corresponding optimum bitumen content as determined in the laboratory, constitutes the job mix formula for implementation during construction.

5.2. While working out the job mix formula, it shall be ensured that it is based on a correct and truly representative sample of materials that will actually be used in the work so that this formula could be adhered to in practice on that specific construction project and that the mix and its different ingredients satisfy the physical and strength requirements of these specifications.

5.3. Alongwith the job mix formula proposed to be used on the work, the following details shall be given :

- (i) Source and location of all materials.
- (ii) Proportions of all materials expressed as follows where each is applicable.

Binder

As percentage by weight of
total mix.

Coarse aggregate
Fine aggregate
Mineral filler.

As percentage by weight of
total aggregate including
mineral filler.

- (iii) A single definite percentage passing each sieve for the mixed aggregate.
- (iv) The results of tests enumerated in Table 1 as obtained for the job mix formula.
- (v) Test results of physical characteristics of aggregates to be used.

5.4. The approved job mix formula shall remain effective unless and until the same is modified and reapproved by the Engineer.

5.5. Should a change in the source of materials be proposed, a new job mix formula shall be established and got approved from the Engineer before actually using the materials.

5.6. Permissible Variations from the Job Mix Formula

Proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix in actual practice shall be ensured. The permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula may be within the limit as specified in Table 4. These variations are intended to apply to individual specimens taken for quality control tests.

TABLE 4. PERMISSIBLE VARIATIONS FROM JOB MIX FORMULA

Sieve Designation	Permissible variations by weight of total aggregates (Per cent passing)	
	Grading 1	Grading 2
22.4 mm	—	—
13.2 mm	—	± 8
11.2 mm and 5.6 mm	± 7	± 7
2.36 mm	± 4	± 4
600 µm	± 3	± 3
150 and 75 µm	± 1	± 1
Binder content (Bitumen)	± 0.3	± 0.3

6. CONSTRUCTION

6.1. Weather and Seasonal Limitations

The work of laying shall not be taken up during rainy or foggy weather or when the base course is damp or wet or during dust storm or when the atmospheric temperature in shade is 10°C or less.

6.2. Preparation of the Base

6.2.1. The base on which bituminous concrete is to be laid shall be prepared, shaped and conditioned to the specified levels, grade and cross section. The surface shall be thoroughly swept clean, scraped and made free from dust, caked mud and other deleterious materials. Where the existing base is potholed or rutted, the same shall be rectified by filling with premixed bituminous material well rammed and compacted.

6.2.2. If the existing base is irregular and wavy it may be considered necessary to provide a suitable profile corrective course of adequate thickness to rectify the profile both longitudinally and transversely before laying the bituminous concrete courses.

6.2.3. In case the existing base is in a distressed condition, it is advisable to adopt suitable remedial measures prior to laying the costly surface course.

6.3. Tack Coat

6.3.1. The work shall consist of application of a single coat of low viscosity liquid bituminous material to the prepared base preparatory to another bituminous construction over it.

6.3.2. The binder used for the tack coat shall be bitumen of a suitable grade appropriate to the region, traffic, rainfall and other environmental conditions and conforming to IS : 73, 217 or 454 or 8887, as applicable or any other approved bituminous material.

6.3.3. A tack coat at the rate of 6 to 7.5 kg of hot bitumen per 10 m² over the bituminous base course if the existing surface is dry and hungry and 5 to 5.5 kg per 10 m² on a normal bituminous surface and 7.5 kg per 10 m² in case of cement concrete surface shall be applied as directed by the Engineer-in-charge.

6.3.4. The surface on which the tack coat is to be applied shall be cleared of any dust and any extraneous material before the application of the binder, by using a mechanical broom or any other approved equipment/method as specified.

6.3.5. Binder shall be heated to the temperature appropriate to the grade of bitumen used and sprayed on the base at the rate specified at para 6.3.3.

6.3.6. The binder shall be applied uniformly with the aid of either self propelled or towed bitumen pressure sprayer with self heating arrangement and spraying nozzles arrangement capable of spraying bitumen at specified rates and temperature so as to provide a uniformly unbroken spread of bitumen.

6.3.7. The tack coat shall be applied just ahead of the on coming bituminous construction.

6.4. Preparation and Transport of Mix

6.4.1. Hot mix plant of adequate capacity and capable of producing a proper and uniform quality mix shall be used for preparing the mix. The plant may be either a weigh batch type or volumetric proportioning continuous or drum mix type. The plant shall have coordinated set of essential units capable of producing uniform mix as per the job mix formula such as :

- (a) Cold aggregate feed system for providing blended aggregate in the correct proportion (called cold binfeed arrangement).
- (b) Rotating cylindrical dryer drum fitted with suitable burner capable of heating the aggregate to the required temperature without any visible unburnt fuel or carbon residue on the aggregate and to reduce the moisture content of the aggregate to the specified minimum level.
- (c) The dryer units shall be filled with approved type of thermometric instruments at appropriate places so as to indicate or automatically record/register the temperature of heated aggregate before adding/mixing the binder.
- (d) Gradation Control : Except in case of Drum Mix Plant, other two types of plants mentioned above shall have :
 - (i) A screening unit for accurate sizing of hot aggregate and feeding the same to mixing unit by weight or volume control as per the specified job mix formula.
 - (ii) Paddle mixer unit shall be capable of producing a homogeneous mix with uniform coating of all particles of the mineral aggregate with binder.

- (e) In case of Drum Mix Plant, the cold feed system shall have variable speed belt conveyors/or other suitable devices for regulating the accurate proportioning of aggregate into an even feed flow automatically from a central operating/central cabin.
- (f) **Bitumen Control Unit**
Capable of measuring/metering and spraying required quantity of bitumen at specified temperature with synchronisation of bitumen and aggregate feed.
- (g) **Filler System**
A fines feeder system suitable to receive bagged or bulk supply of filler material and for its incorporation to the mix in the correct quantity.
- (h) **Dust Control**
A suitable built-in dust control equipment for the dryer to contain the exhaust of fine dust into atmosphere for environmental control, wherever so specified by the Engineer.
- (i) Suitable Auxilliary Bitumen Boiler of adequate capacity self heating arrangement and temperature control device. The boiler should be fitted with temperature indicating instruments.

6.4.2. The temperature of binder at the time of mixing shall be in the range of 150°-177°C and of aggregates in the range of 153°-163°C. Provided also that at no time shall the difference in temperature between the aggregates and binder exceed 14°C.

6.4.3. Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particles of the mineral aggregates are coated uniformly.

6.4.4. The mix shall be transported from the mixing plant to the point of use in suitable tipper vehicles. The vehicles employed for transport shall be clean and be covered in transit if required from site conditions.

6.5. Spreading of the Mix

6.5.1. The mix transported from the hot mix plant to the site shall be spread by means of a self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix to specified, grade lines and cross section. Paver Finisher shall have the following essential features :

- (a) Loading hoppers and suitable distributing mechanism.
- (b) Hydrostatic drive/control for all drives.
- (c) Hydraulically extendable screed for appropriate width requirement.

- (d) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting otherwise marring the surface. It shall have adjustable amplitude and infinitely variable frequency.
- (e) Necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.
- (f) Electronic sensing device for automatic levelling and profile control within the specified tolerances.
- (g) Internal heating arrangement for the screed.

6.5.2. However, in restricted locations and in narrow widths where the available plant can not be operated, manual laying of the mix may be permitted. The mix should be spread in such a manner that after compaction, the required thickness of wearing course is uniformly obtained.

6.5.3. Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. Longitudinal joints shall be offset by at least 150 mm from those in the lower course. All joints, longitudinal, transverse and construction, shall be cut vertical to the full thickness of the previously laid mix and the cut surface painted with hot bitumen before placing fresh material.

6.6. Rolling and Compaction

6.6.1. After spreading by paver, the mix shall be thoroughly compacted by rolling with a set of rollers moving at a speed of not more than 5 km per hour, immediately following close to the paver. The initial or breakdown rolling shall be with 8 to 12 tonne three wheeled steel roller and the finished rolling with 8 to 10 tonne tandem roller. Before finishing with the tandem roller, breakdown rolling shall be preferably followed by an intermediate rolling with a smooth wheel pneumatic roller of 15 to 30 tonne capacity having a tyre pressure of 7 kg/cm². All the compaction operations i.e. break down rolling, intermediate rolling and finished rolling can be accomplished by using vibratory roller of 8 to 10 tonne static weight. During the initial or breakdown rolling and finished rolling, the vibratory system shall be switched off. The joints and edges shall be rolled with 8 to 10 tonne three wheeled static roller.

The wheels of roller shall be kept moist to prevent the mix from adhering to them. But in no case shall fuel/lubricating oil be used for this purpose nor excessive water poured on the wheels. Rolling shall commence longitudinally from edge and proceed towards the centre, except that on superelevated points,

it shall progress from the lower to upper edge parallel to the centre line of the pavement. The roller shall proceed on the fresh material with rear or fixed wheel leading so as to minimise the pushing of the mix and each pass of the roller shall overlap the preceeding one by half the width of the rear wheel.

6.6.2. Rolling operations shall be conducted when the mix is neither too hot nor too cold so that shoving or hair cracks may be eliminated. Rolling shall be continued till the density achieved is at least 98 per cent of that of Laboratory Marshall Specimen and all roller marks are eliminated.

6.6.3. Rolling operations shall be completed in all respects before the temperature of the mix falls below 100°C.

7. OPENING TO TRAFFIC

Traffic may be allowed after completion of the final rolling when the mix has cooled down to the surrounding temperature.

8. CONTROLS

8.1. Adequate quality control at every stage of work is essential and as such a field laboratory must be set up to ensure the following controls :

8.1.1. Periodic sieve analysis of each type of the aggregate at the cold feeder should be made to see that the gradation of aggregate follow the job mix formula. The number of samples per day would depend upon the number of bulk supply of the aggregates made in a day at the plant site. The physical properties as required, in Table 2 shall be determined at the rate of one test each for every 50—100 m³ of aggregates. Filler grading shall be tested at the rate of one test for every 5 m³ of filler.

8.1.2. For mix grading one set of tests on individual constituent and mixed aggregate from the dryer for each 100 tonnes of mix subject to a minimum of two sets per plant per day will be done.

8.1.3. Periodic check of the aggregate at the gradation control unit (if fitted with one) or at the hot mix gates should be made to see that the proportion of the aggregates as specified in the job wise formula, is complied with.

8.1.4. Periodic check on penetration and softening point of the binder should also be done in the manner specified in IS : 1203 and IS : 1205.

8.1.5. It shall be ensured that the aggregates are not totally wet in which case it would affect the output of the plant adversely. The temperature measuring device installed at the end of dryer should be checked periodically to see that the aggregate temperature never exceeds 163°C . A tolerance upto 10°C on the lower side could be permitted.

8.1.6. The bitumen temperature should be well within the limits specified. The viscosity of heated bitumen shall be between 150 and 300 centi stocks for which the normal temperature range for paving bitumen is 150°C — 177°C .

8.1.7. At no time the difference in temperature of aggregate and bitumen should exceed 14°C .

8.1.8. At least one sample for every 100 tonnes of bituminous mix discharged at the pugmill chute shall be collected and the following tests done subject to a minimum of two sets being tested per plant per day.

- (i) 3 Marshall specimens shall be compacted and tested for the stability, flow value, voids content and density. The average value should closely follow the Laboratory design value.
- (ii) Bitumen shall be extracted from about 1000 grams of the mix and bitumen content determined.
- (iii) A sieve analysis of the aggregates after the bitumen is extracted, shall be done and the gradation determined.

8.1.9. The temperature of the mix at the time of laying shall not exceed 160°C and shall not be less than 120°C . Care should be taken to ensure completion of compaction before the temperature falls below the limit specified in para 8.2.

8.2. Rolling operation shall be completed in every respect before the temperature of the mix falls below 100°C .

8.3. After the mix is compacted the thickness laid may be checked by noting the depth of penetration of hot steel scale. This shall also be correlated with the measured area of the surface laid and the total plant output of the mix in tonnes (as given in the plant scale).

8.4. For every 1000 m² or less of compacted surface, one field density test should be conducted to determine the density of the mix as laid, compacted and finished. The bulk density shall not be less than 98 per cent of the Laboratory density.

8.5. The longitudinal profile of the finished surface shall be tested with a straight edge 4.5 m long parallel to the centre line and the transverse profile with a camber plate. Any irregularity greater than 4 mm shall be corrected. The longitudinal profile of the finished surface shall also be tested with a roughometer/profilometer and it should be ensured that the roughness shall not exceed 2000 mm per kilometre.

8.6. Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.

